

REMARKS/ARGUMENTS**I. General Remarks**

The application has been reviewed in light of the Final Office Action mailed January 10, 2006. At the time of the Final Office Action, claims 1-34 were pending in this application. Applicants gratefully acknowledge Examiner's designation of claims 5-16 and 19-34 as allowable subject-matter.

Claims 1-4, 17, and 18 stand rejected in view of prior art. For the reasons discussed below, the Applicants believe that all of the remaining claims are patentable over the cited prior art, and therefore respectfully traverse Examiner's rejection.

II. Rejections under 35 U.S.C. § 102(b)

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by either U.S. Patent 6,561,275 issued to Glass *et al.* (hereinafter *Glass*) or U.S. Patent No. 6,457,528 issued to Staudt *et al.* (hereinafter *Staudt*). The Office Action argues that Applicants are attempting to read limitations from the specification into the claims as follows:

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the "at least one valve" is not a rupture disc) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Office Action at 3. In rebuttal, Applicants are not arguing that limitations from the specification should be read into the claims, but instead that the claim terms should be interpreted according to their ordinary and customary meanings in light of the specification. As explained below, the claim term "valve" simply cannot include as part of its definition the term, "rupture disc." As set forth in MPEP § 2111.01(II), Rev. 3 (2005), claim terms should be interpreted according to their ordinary and customary meanings as understood by a person of ordinary skill in the art at the time of the invention. Indeed, the MPEP explains as follows:

[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Phillips v. AWH Corp.*, ___ F.3d ___, 75 USPQ2d 1321 (Fed. Cir. 2005) (en banc).<

Sunrace Roots Enter. Co. v. SRAM Corp., 336 F.3d 1298, 1302, 67 USPQ2d 1438, 1441 (Fed. Cir. 2003); *Brookhill-Wilk 1, LLC v. Intuitive Surgical, Inc.*, 334 F.3d 1294, 1298 67 USPQ2d 1132, 1136 (Fed. Cir. 2003) ("In the absence of an express intent to impart a novel meaning to the claim terms, the words are presumed to take on the ordinary and customary meanings attributed to them by those of ordinary skill in the art."). It is the use of the words in the context of the written description and customarily by those skilled in the relevant art that accurately reflects both the "ordinary" and the "customary" meaning of the terms in the claims. *Ferguson Beauregard/Logic Controls v. Mega Systems*, 350 F.3d 1327, 1338, 69 USPQ2d 1001, 1009 (Fed. Cir. 2003).

MPEP § 2111.01(II). Nowhere in Applicants' Specification is it taught that that the term "valve" encompasses a rupture disc. Applicants respectfully submit that the recitation of "at least one valve" recited in claim 1 does not include a rupture disc. One of ordinary skill in the art would distinguish a "valve" from a "rupture disc" by whether the device was reclosable or nonreclosable. For example, the MCGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS (2003) and *The National Board of Boiler and Pressure Vessel Inspectors* define a rupture disc as a device that is classified as a *nonreclosing* pressure relief device, and a relief valve as a device that relieves pressure beyond a specified limit and then *recloses* when the pressure drops below the opening pressure. See MCGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, 1664, 1841 (6th ed. 2003) and NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS, INSPECTOR GUIDE FOR PRESSURE RELIEF DEVICES, *available at* http://www.nationalboard.org/NationalBoard/CommissionedInspectors/InspectorGuides/CInsp_Guide_Prd.aspx (last visited February 28, 2006 (See enclosed courtesy copies). One of ordinary skill in the art would understand that the term "valve" does not include a rupture disc. As the enclosed publications show, a rupture disc is *nonreclosable*, whereas a valve is *reclosable*. Accordingly, these terms should be given their ordinary and customary meanings as understood by a person of ordinary skill in the art at the time of the invention interpreted in light of Applicants' specification. To include the "rupture disc" within the definition of the term "valve" would be abject to the ordinary and customary meaning of the term "valve" interpreted in light of Applicants' specification. Thus, Applicants respectfully submit that Applicants' specification does not vary the term "valve" as used in claim 1 so as to include a "rupture disc."

Further, as described in the specification, the rupture disc(s) of the present invention may be used in conjunction with the "at least one valve" of claim 1. Applicants

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respectfully submit that the claims of present invention signify two devices are different and mutually exclusive, because the claims specify that a rupture disc could be used in the apparatus in addition to the valve. *See, e.g.,* Claims 5 and 22, Specification, ¶¶ 14, 49-51, and Figures 11A-11C. Thus, Figures 11A-11C show one example of how rupture discs may be used in conjunction with the “at least one valve” of claim 1. Rupture discs 210 and 212 are disposed within a pair of inlet ports 206 and 208 to block the flow of fluid into the central bore until the annular fluid pressure reaches a desired predetermined burst value. In this way, rupture discs 210 and 212 may protect a downstream valve (such as the valve depicted in Figure 11C) from exposure to fluids and solids, which could cause plugging and/or other operational problems to the valve downstream of the rupture discs.

Given that the term “valve” as used in claim 1 does not include a “rupture disc,” the cited references, *Glass* and *Staudt*, each independently fail to anticipate Applicants’ claim 1. To form a basis for a 35 U.S.C. § 102(b) rejection, a prior art reference must disclose each and every element as set forth in the claim. *See* MPEP § 2131. In particular, *Glass* and *Staudt* each independently fail to disclose “at least one valve disposed in the housing, which opens in response to a predetermined annular fluid pressure enabling fluid to pass from an outer annulus between adjacent nested casing strings disposed outside the housing to an annulus between different adjacent nested casing strings disposed inside the hollow inner cavity.” Thus, the cited references, each standing alone, do not contain each and every element of the claimed invention and accordingly, not one of them anticipates Applicants’ *amended* claims.

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III. Rejections under 35 U.S.C. § 103(a)

Claims 2-4, 17, and 18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over either U.S. Patent 6,561,275 issued to *Glass et al.* (hereinafter *Glass*) or U.S. Patent No. 6,457,528 issued to *Staudt et al.* (hereinafter *Staudt*) in view of U.S. Patent No. 5,697,442 issued to *Baldrige et al.* (hereinafter *Baldrige*) or Great Britain Patent No. 2,171,436 issued to *Mikolajczyk et al.* (hereinafter *Mikolajczyk*). With respect to this rejection the Examiner stated:

... it would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the well casing of *Glass et al.* or *Staudt* with such blades as claimed because either *Baldrige* or *Mikolajczyk* teach providing a well casing with a stabilizer including such blades in order to maintain the casing

centered, thereby providing a cement column of substantially uniform thickness (col. 1, line 48 through column 2, line 6 in Baldridge; page 1, lines 12-21).

...

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Office Action at 2-4. Applicants respectfully traverse because the Examiner has not established a *prima facie* case of obviousness, in that the cited references do not teach or suggest each and every claim limitation and that there is no suggestion or motivation to combine the references with a reasonable expectation of success. See MPEP § 2142.

First, the cited references do not teach each and every claim limitation. In particular, independent claim 1 recites "at least one valve." Rather than disclosing a "valve," *Glass* and *Staudt* are directed to a "rupture disc." Accordingly, neither *Glass* nor *Staudt* teach or suggest "at least one valve." Additionally, *Baldridge* and *Mikolajczyk* also fail to supply this missing recitation. As discussed previously in Section II, the term "at least one valve" does not include a rupture disc. One of ordinary skill in the art would define a valve as a *reclosable* device and a rupture disc as a *nonreclosable* device, as described in Section II above. Accordingly, the combination of *Glass* or *Staudt* in view of *Baldridge* or *Mikolajczyk* fails to teach or suggest each and every limitation of claim 1. Accordingly, the cited references cannot form a proper basis for a *prima facie* case of obviousness. As such, Applicants respectfully request withdrawal of the 35 U.S.C. § 103(a) rejection as to dependent claims 2-4, 17, and 18, which depend from independent claim 1.

Second, there is no suggestion or motivation to combine the references with a reasonable expectation of success. See MPEP § 2142. "Obviousness can only be established by . . . modifying the teaching of the prior art where there is some teaching, suggestion, or motivation to do so found in the references themselves or in the knowledge generally available to one of ordinary skill in the art." MPEP § 2143.01. Applicants respectfully submit that Examiner still has not pointed to any suggestion or motivation to combine the teachings of *Glass*, *Staudt*,

Baldrige, and *Mikolajczyk* that is present in the cited references themselves. The Examiner has provided no evidence or finding of the specific understanding or principle within the knowledge of a person of ordinary skill in the art at the time of the invention that would have supplied the motivation to combine the cited references. *See* MPEP § 2143.01. Nor has the Examiner shown that the ordinary and customary meaning of the term “valve” includes a rupture disc.

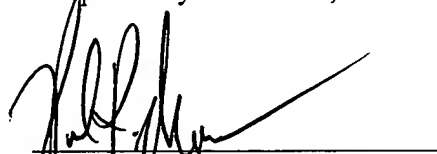
Therefore, independent claim 1 is not obviated by *Glass* or *Staudt* in view of *Baldrige* or *Mikolajczyk*. The remaining rejected claims depend either directly or indirectly on independent claim 1. All of these dependent claims, which include all the limitations of their corresponding independent claim, are allowable for at least the reasons cited above with respect to independent claim 1. Accordingly, Applicants respectfully request withdrawal of this rejection with respect to claims 2-4, 17, and 18.

SUMMARY

In light of the above remarks and amendments, Applicants respectfully request reconsideration and withdrawal of the outstanding objections and rejections. Applicants further submit that the application is now in condition for allowance, and earnestly solicit timely notice of the same. Should the Examiner have any questions, comments or suggestions in furtherance of the prosecution of this application, the Examiner is invited to contact the attorney of record by telephone, facsimile, or electronic mail.

Applicants believe that no fees are due in association with the filing of this response. However, should the Commissioner deem that any additional fees are due, including any fees for extensions of time, Applicants respectfully request that the Commissioner accept this as a Petition Therefor, and direct that any additional fees be debited from Baker Botts L.L.P., Deposit Account No. 02-0383, Order Number 063718.0427 for any underpayment of fees that may be due in association with this filing.

Respectfully submitted,



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On the cover: Representation of a fullerene molecule with a noble gas atom trapped inside. At the Permian-Triassic sedimentary boundary the noble gases helium and argon have been found trapped inside fullerenes. They exhibit isotope ratios quite similar to those found in meteorites, suggesting that a fireball meteorite or asteroid exploded when it hit the Earth, causing major changes in the environment. (Image copyright © Dr. Luann Becker. Reproduced with permission.)

Over the six editions of the Dictionary, material has been drawn from the following references: G. M. Garrity et al., *Taxonomic Outline of the Prokaryotes*, Release 2, Springer-Verlag, January 2002; D. W. Linzey, *Vertebrate Biology*, McGraw-Hill, 2001; J. A. Pechenik, *Biology of the Invertebrates*, 4th ed., McGraw-Hill, 2000; *U.S. Air Force Glossary of Standardized Terms*, AF Manual 11-1, vol. 1, 1972; F. Casey, ed., *Compilation of Terms in Information Sciences Technology*, Federal Council for Science and Technology, 1970; *Communications-Electronics Terminology*, AF Manual 11-1, vol. 3, 1970; P. W. Thrush, comp. and ed., *A Dictionary of Mining, Mineral, and Related Terms*, Bureau of Mines, 1968; *A DOD Glossary of Mapping, Charting and Geodetic Terms*, Department of Defense, 1967; J. M. Gilliland, *Solar-Terrestrial Physics: A Glossary of Terms and Abbreviations*, Royal Aircraft Establishment Technical Report 67158, 1967; W. H. Allen, ed., *Dictionary of Technical Terms for Aerospace Use*, National Aeronautics and Space Administration, 1965; *Glossary of Stinfo Terminology*, Office of Aerospace Research, U.S. Air Force, 1963; *Naval Dictionary of Electronic, Technical, and Imperative Terms*, Bureau of Naval Personnel, 1962; R. E. Huschke, *Glossary of Meteorology*, American Meteorological Society, 1959; *ADP Glossary*, Department of the Navy, NAVSO P-3097; *Glossary of Air Traffic Control Terms*, Federal Aviation Agency; *A Glossary of Range Terminology*, White Sands Missile Range, New Mexico, National Bureau of Standards, AD 467-424; *Nuclear Terms: A Glossary*, 2d ed., Atomic Energy Commission.

**McGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS,
Sixth Edition**

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pressure point [PHYSIO] A point of marked sensibility to pressure or weight, arranged like the temperature spots, and showing a specific end apparatus arranged in a punctate manner and connected with the pressure sense. { 'presh-ər pɔɪnt }

pressure process [CHEM ENG] Treatment of timber to prevent decay by forcing a preservative such as creosote and zinc chloride into the cells of the wood. { 'presh-ər prɛs-əs }

pressure radius [PETRO ENG] The effective radius of increased reservoir pressure surrounding a water-injection well. { 'presh-ər ræd-ē-əs }

pressure rating [ENG] The operating (allowable) internal pressure of a vessel, tank, or piping used to hold or transport liquids or gases. { 'presh-ər ræd-ɪŋ }

pressure-regulating valve [ENG] A valve that releases or holds process-system pressure (that is, opens or closes) either by preset spring tension or by actuation by a valve controller to assume any desired position between full open and full closed. { 'presh-ər reg-yə-lād-ɪŋ vɒlv }

pressure regulator [ENG] Open-close device used on the vent of a closed, gas-pressured system to maintain the system pressure within a specified range. { 'presh-ər reg-yə-lād-ər }

pressure release [GEOPHYS] The outward-expanding force of pressure which is released within rock masses by unloading, as by erosion of superincumbent rocks or by removal of glacial ice. { 'presh-ər rɪ-lēs }

pressure-release jointing [GEOL] Exfoliation that occurs in once deeply buried rock that erosion has brought nearer the surface, thus releasing its confining pressure. { 'presh-ər rɪ-lēs jɔɪnt-ɪŋ }

pressure relief [ENG] A valve or other mechanical device (such as a rupture disk) that eliminates system overpressure by allowing the controlled or emergency escape of liquid or gas from a pressured system. { 'presh-ər rɪ-lēf }

pressure-relief device [MECH ENG] 1. In pressure vessels, a device designed to open in a controlled manner to prevent the internal pressure of a component or system from increasing beyond a specified value, that is, a safety valve. 2. A spring-loaded machine part which will yield, or deflect, when a predetermined force is exceeded. { 'presh-ər rɪ-lēf dɪ-vɪs }

pressure-relief valve [MECH ENG] A valve which relieves pressure beyond a specified limit and recloses upon return to normal operating conditions. { 'presh-ər rɪ-lēf vɒlv }

pressure resistance [FL MECH] In fluid dynamics, a normal stress caused by acceleration of the fluid, which results in a decrease in pressure from the upstream to the downstream side of an object acting perpendicular to the boundary. Also known as pressure drag. { 'presh-ər rɪ-zɪs-təns }

pressure-retaining member [MECH ENG] That part of a pressure-relieving device loaded by the restrained pressurized fluid. { 'presh-ər rɪ-tān-ɪŋ mem-bər }

pressure ridge [GEOL] 1. A seismic feature resulting from transverse pressure and shortening of the land surface. 2. An elongate upward movement of the congealing crust of a lava flow. 3. A ridge of glacier ice. [OCEANOGR] A ridge or wall of hummocks where one ice floe has been pressed against another. { 'presh-ər rɪdʒ }

pressure ring [MIN ENG] A ring about a large excavated area, evidenced by distortion of the openings near the main excavation. { 'presh-ər rɪŋ }

pressure-rise center [METEOROL] A point of maximum increase in atmospheric pressure over a specified interval of time; on synoptic charts, a point of maximum positive pressure tendency. Also known as anallorbaric center; center of rises; isallorbaric high; isallorbaric maximum. { 'presh-ər rɪz sɛn-tər }

pressure roll [ENG] In plastics-extrusion coating, the roll that with the chill roll applies pressure to the substrate and the molten extruded web. { 'presh-ər rɒl }

pressure seal [ENG] A seal used to make pressure-proof the interface (contacting surfaces) between two parts that have frequent or continual relative rotational or translational motion. { 'presh-ər sɛl }

pressure-sensitive adhesive [MATER] An adhesive that develops maximum bonding power when applied by a light pressure only. { 'presh-ər sɛn-səd-ɪv ad'hɛ-sɪv }

pressure-sensitive paint [FL MECH] A flow visualization technique in which ultraviolet light is used to excite specific molecules in a special paint affixed to a test surface positioned in a wind tunnel flow. The resulting phosphorescence of these

molecules indicates the amount of oxygen in contact with the paint and, thereby, the spatial distribution of surface pressure. { 'presh-ər sɛn-səd-ɪv pænt }

pressure shadow [PETR] In structural petrology, an area adjoining a porphyroblast, characterized by a growth fabric rather than a deformation fabric, as seen in a section perpendicular to the *b* axis of the fabric. Also known as pressure fringe-strain shadow. { 'presh-ər shad-ə }

pressure shift [SPECT] An increase in the wavelength in which a spectral line has maximum intensity, which takes place when pressure is increased. { 'presh-ər shift }

pressure solution [PETR] In a sedimentary rock, solution occurring preferentially at the grain boundary surfaces. Also known as pressolution. { 'presh-ər sɒ-lju-shən }

pressure-stabilized [AERO ENG] Referring to membrane-type structures that require internal pressure for maintenance of a stable structure. { 'presh-ər stā-bə-lɪzd }

pressure still [CHEM ENG] A continuous-flow, petroleum-refinery still in which heated oil (liquid and vapor) is kept under pressure so that it will crack (decompose into smaller molecules) to produce lower-boiling products (pressure distillate or pressure naphtha). { 'presh-ər stɪl }

pressure storage [ENG] The storage of a volatile liquid or liquefied gas under pressure to prevent evaporation. { 'presh-ər stɔr-ɪdʒ }

pressure suit [AERO ENG] A garment designed to provide pressure upon the body so that respiratory and circulatory functions may continue normally, or nearly so, under low-pressure conditions such as occur at high altitudes or in space without benefit of a pressurized cabin. { 'presh-ər sɪt }

pressure suppression See vapor suppression. { 'presh-ər sɒ-presh-ən }

pressure surface See potentiometric surface. { 'presh-ər sɒr-fas }

pressure-surface map See potentiometric map. { 'presh-ər sɒr-fas mæp }

pressure survey [MIN ENG] A study to determine the pressure distribution or pressure losses along consecutive lengths or sections of a ventilation circuit. [PETRO ENG] The measurement of static bottomhole pressures in an oil field with producing wells shut in for a time interval sufficient for reservoir pressure buildup to stabilize. { 'presh-ər sɒr-və }

pressure switch [ELEC] A switch that is actuated by a change in pressure of a gas or liquid. { 'presh-ər swɪtʃ }

pressure system [ENG] Any system of pipes, vessels, tanks, reactors, and other equipment, or interconnections thereof, operating with an internal pressure greater than atmospheric. [METEOROL] An individual cyclonic-scale feature of atmospheric circulation, commonly used to denote either a high or a low, less frequently a ridge or a trough. { 'presh-ər sis-təm }

pressure tank [CHEM ENG] A pressurized tank into which timber is inserted for impregnation with preservative. [AERO ENG] An airtight water tank in which air is compressed to exert pressure on the water and which is used in connection with a water distribution system. { 'presh-ər tæŋk }

pressure tap [ENG] A small perpendicular hole in the wall of a pressurized, fluid-containing pipe or vessel; used for connection of pressure-sensitive elements for the measurement of static pressures. Also known as piezometer opening, static pressure tap. { 'presh-ər tæp }

pressure tendency [METEOROL] The character and amount of atmospheric pressure change for a 3-hour or other specified period ending at the time of observation. Also known as barometric tendency. { 'presh-ər ten-dən-sē }

pressure-tendency chart See pressure-change chart. { 'presh-ər ten-dən-sē ʃɑrt }

pressure tensor [PL PHYS] A tensor which plays a role in magnetohydrodynamics analogous to that of the pressure in ordinary fluid mechanics. { 'presh-ər ten-sər }

pressure thrust [AERO ENG] In rocketry, the product of the cross-sectional area of the exhaust jet leaving the nozzle exit and the difference between the exhaust pressure and the ambient pressure. { 'presh-ər θrəst }

pressure topography See height pattern. { 'presh-ər tɒp-ə-grəfi }

pressure transducer [ENG] An instrument component that detects a fluid pressure and produces an electrical signal related to the pressure. Also known as electrical pressure transducer. { 'presh-ər tranz-dy-ŋsər }

runway temperature [METEOROL] The temperature of the air just above the runway at an airport (usually at about 4 feet or 1.2 meters but ideally at engine or wing height), used in the determination of density altitude; therefore, runway temperature observations are made and reported at airports when critical values of density altitude prevail. { 'rən,wā ,tem.prə.chər }

runway visibility [METEOROL] The visibility along an identified runway, determined from a specified point on the runway with the observer facing in the same direction as a pilot using the runway. { 'rən,wā ,viz.ə'bil.əd.ē }

runway visual range [METEOROL] The maximum distance along the runway at which the runway lights are visible to a pilot after touchdown. { 'rən,wā 'vɪz.ə.wəl 'rænj }

Rupelian [GEOL] A European stage of middle Oligocene geologic time, above the Tongrian and below the Chattian. Also known as Stampian. { rü'pel-yən }

rupicolous [ECOL] Living among or growing on rocks. { rü'pik-ə-ləs }

Rüping process [ENG] A system for preservative treatment of wood by using positive initial pressure, followed by introduction of the preservative and release of air, creating a vacuum. { 'rüp.ɪŋ ,prə'sæs }

rupture See fracture. See hernia. { 'rəp.chər }

rupture disk See burst disk. { 'rəp.chər ,disk }

rupture disk device [MECH ENG] A nonreclosing pressure relief device which relieves the inlet static pressure in a system through the bursting of a disk. { 'rəp.chər ,disk dɪ.vɪs }

rupture zone [GEOL] The region immediately adjacent to the boundary of an explosion crater, characterized by excessive in-place crushing and fracturing where the stresses produced by the explosion have exceeded the ultimate strength of the medium. { 'rəp.chər ,zɒn }

rural radio service [COMMUN] A radio service used to provide public message communication service between a central office and subscribers located in rural areas to which it is impracticable or uneconomic to run wire lines. { 'rūr-əl 'rād-ē-ō ,sər.vəs }

Rusa oil See palmarosa oil. { 'rū-sə ,ɔɪl }

Rushton-Oldshue column [CHEM ENG] A mixing unit used for continuous pipeline blending in which two-phase contacting is desired; it is a column containing separation plates, baffles, and mixing impellers. { 'rəʃ-tən 'ɔl,ʃu ,kæl-əm }

Russell bodies [PATH] Hyaline eosinophilic globules 4-5 micrometers in diameter, thought to be particles of antibody globulin, occurring in the cytoplasm of plasma cells in chronic inflammatory exudates. { 'rəs-əl ,bəd-ēz }

Russell diagram See Hertzprung-Russell diagram. { 'rəs-əl ,dɪ-ə,gram }

Russell effect [GRAPHICS] The formation of latent developable images on a photographic film or paper by an agent other than electromagnetic radiation, such as a resin, metal, volatile liquid, or printing ink. Also known as Vogel-Colson-Russell effect. { 'rəs-əl i,fekt }

Russell flask [PETRO ENG] Device for volumetric determination of the true volume of sand grains within a unit bulk volume of grains plus voids. { 'rəs-əl ,flask }

russellite [MINERAL] Bi_2WO_6 A pale yellow to greenish, tetragonal mineral consisting of an oxide of bismuth and tungsten; occurs as fine-grained compact masses. { 'rəs-əl,ɪt }

Russell mixture [ASTROPHYS] A mixture of elements with the same relative proportions as are found in the sun and other stars. { 'rəs-əl ,mɪks.chər }

Russell movable-wall oven [CHEM ENG] An oven for coal carbonization which cokes a 400-pound (180-kilogram) charge in a horizontal, 12-inch-wide (30-centimeter) chamber, heated from both sides, but with one side floating and balanced against scales. { 'rəs-əl 'mʊv-ə-bəl 'wɔl ,əv-ən }

Russell-Saunders coupling [PHYS] A process for building many-electron single-particle eigenfunctions of orbital angular momentum and spin; the orbital functions are combined to make an eigenfunction of the total orbital angular momentum, the spin functions are combined to make an eigenfunction of the total spin angular momentum, and then the results are combined into eigenfunctions of the total angular momentum of the system. Also known as LS coupling. { 'rəs-əl 'sɒn-dəz ,kʌp.lɪŋ }

Russell's paradox [MATH] The paradox concerning the concept of all sets which are not members of themselves which

forces distinctions in set theory between sets and classes. { 'rəs-əlz 'pɑr-ə'dæks }

Russell's viper See tic polonga. { 'rəs-əlz 'vɪ-pər }

Russell-Vogt theorem See Vogt-Russell theorem. { 'rəs-əl 'vɒt 'θɪr-əm }

rust [MET] The iron oxides formed on corroded ferrous metals and alloys. [PL PATH] Any plant disease caused by rust fungi (Uredinales) and characterized by reddish-brown lesions on the plant parts. { rəst }

rust fungi See Urediniomycetes. { 'rəst ,fʌŋ,ɪ }

rusting [GEOL] The formation of red, yellow, or brown iron oxide minerals by oxidation of mineral deposits. [MET] The formation of rust on ferrous metals and alloys. { 'rəst.ɪŋ }

rust joint [ENG] A joint to which some oxidizing agent is applied either to cure a leak or to withstand high pressure. { 'rəst ,dʒɔɪnt }

rust prevention [ENG] Surface protection of ferrous structures or equipment to prevent formation of iron oxide; can be by coatings, surface treatment, plating, chemicals, cathodic arrangements, or other means. { 'rəst prɪ,ven.chən }

rust preventive [MATER] One of a group of products, often with petroleum thinners, used to prevent corrosion to metal surfaces. { 'rəst prɪ,ven.tɪv }

rusty blotch [PL PATH] A fungus disease of barley caused by *Helminthosporium californicum* and characterized by brown blotches on the foliage. { 'rəs-tē 'blætʃ }

rusty gold [MET] Native gold that has a thin coat of iron oxide or silica that prevents it from amalgamating readily. { 'rəs-tē 'gɒld }

rusty mottle [PL PATH] A virus disease of cherry characterized by retarded development of blossoms and leaves in the spring, followed by necrotic spotting and shot-holing of the foliage with considerable defoliation. { 'rəs-tē 'mɒd-əl }

rut [PHYSIO] The period during which the male animal has a heightened mating drive. { rət }

rutabaga [BOT] *Brassica napobrassica*. A biennial crucifer of the order Capparales probably resulting from the natural crossing of cabbage and turnip and characterized by a large, edible, yellowish fleshy root. { 'rʊd-ə'bɑ-gə }

Rutaceae [BOT] A family of dicotyledonous plants in the order Sapindales distinguished by mostly free stamens and glandular-punctate leaves. { rʊ'tæs-ē-ē }

ruthenic chloride See ruthenium chloride. { rʊ'then-ɪk 'klɔr,ɪd }

ruthenium [CHEM] A chemical element, symbol Ru, atomic number 44, atomic weight 101.07. [MET] A hard, brittle, grayish-white metal used as a catalyst; workable only at high temperatures. { rʊ'thē-nē-əm }

ruthenium chloride [INORG CHEM] RuCl_3 Black, deliquescent, water-insoluble solid that decomposes in hot water and above 500°C; used as a laboratory reagent. Also known as ruthenic chloride; ruthenium sesquichloride. { rʊ'thē-nē-əm 'klɔr,ɪd }

ruthenium halide [INORG CHEM] Halogen compound of ruthenium; examples are RuCl_2 , RuCl_3 , RuCl_4 , RuBr_3 , and RuF_5 . { rʊ'thē-nē-əm 'hɑ,lɪd }

ruthenium red [INORG CHEM] $\text{Ru}_2(\text{OH})_2\text{Cl}_4 \cdot 7\text{NH}_3 \cdot 3\text{H}_2\text{O}$ A water-soluble, brownish-red powder; used as an analytical reagent and stain. { rʊ'thē-nē-əm 'red }

ruthenium sesquichloride See ruthenium chloride. { rʊ'thē-nē-əm ,ses'kwɪ'klɔr,ɪd }

ruthenium tetroxide [INORG CHEM] RuO_4 A yellow, toxic solid, melting at 25°C; used as an oxidizing agent. { rʊ'thē-nē-əm te'trɒk,sɪd }

rutherford [NUCLEO] Abbreviated rd. 1. A unit used to express the decay rate of radioactive material, equal to 10^6 disintegrating atoms per second. 2. That amount of a substance which is undergoing 10^6 disintegrations per second. { 'rʌθ-ər-fərd }

Rutherford backscattering spectrometry [SPECT] A method of determining the concentrations of various elements as a function of depth beneath the surface of a sample, by measuring the energy spectrum of ions which are backscattered out of a beam directed at the surface. { 'rʌθ-ər-fərd 'bæk ,skɑd-ə-rɪŋ spek'trəm-ə-trē }

rutherfordine [MINERAL] $(\text{UO}_2)(\text{CO}_3)$ A yellow mineral composed of uranyl carbonate, occurring as masses of fibers. { 'rʌθ-ər-fərd,ɛn }

rutherfordium [CHEM] A chemical element, symbolized Rf,

Inspector Guide for Pressure Relief Devices

1. Description and Overview

Pressure relief devices are used to provide a means of venting excess pressure which could rupture a boiler or pressure vessel. A pressure relief device is the last line of defense for safety. If all other safety devices or operating controls fail, the pressure relief device must be capable of venting excess pressure.

There are many types of pressure relief devices available for use in the boiler and pressure vessel industry. This inspector guide will address the most common devices found on boilers and pressure vessels. Virtually all jurisdictions require a pressure relief device to be manufactured and certified in accordance with the ASME Code in addition to being capacity-certified by the National Board.

The most common types of pressure relief devices are:

- Safety Valve -- This device is typically used for steam or vapor service. It operates automatically with a full-opening pop action and recloses when the pressure drops to a value consistent with the blowdown requirements prescribed by the applicable governing code or standard.
- Relief Valve -- This device is typically used for liquid service. It operates automatically by opening farther as the pressure increases beyond the initial opening pressure and recloses when the pressure drops below the opening pressure.
- Safety Relief Valve -- This device includes the operating characteristics of both a safety valve and a relief valve and may be used in either application.
- Temperature and Pressure Safety Relief Valve -- This device is typically used on potable water heaters. In addition to its pressure-relief function, it also includes a temperature-sensing element which causes the device to open at a predetermined temperature regardless of pressure. The set temperature on these devices is usually 210°F.
- Rupture Disk -- This device is classified as nonreclosing since the disk is destroyed upon actuation. This type of device may be found in use with a pressure vessel where a spring-loaded pressure relief device is inappropriate due to the operating conditions or environment.

2. Common Observations and Problems

Pressure relief devices must operate as designed in order to perform their required task. Different types of problems can prevent normal operation:

- The inlet piping connected to the device must not be smaller in diameter than the inlet opening of the device. An inlet pipe that is smaller than the device inlet opening could alter the operating characteristics for which the device was designed.
- The discharge piping connected to the device must be no smaller than the discharge opening of the device. A discharge pipe that is smaller than the device discharge opening could cause pressure to develop on the discharge side of the device while operating.
- Multiple devices discharging into a discharge manifold or header is a common practice. The discharge manifold or header must be sized so the cross-sectional area is equal to or greater than the sum of the discharge cross-sectional areas of all

the devices connected to the discharge manifold or header. Failing this requirement, the devices would be subjected to pressure on the discharge side of the device while operating. Even a small amount of pressure here could adversely affect the operation of the device.

- Constant leakage of the device can cause a build-up of scale or other solids around the discharge opening. This build-up can prevent the device from operating as designed.
- Discharge piping connected to the device must be supported so as not to impart any loadings on the body of the device. These loadings could affect or prevent the proper operation of the device including proper reclosure after operating.
- Some devices, especially on larger boilers, may have a discharge pipe arrangement which incorporates provisions for expansion as the boiler heats up or cools down. These expansion provisions must allow the full range of movement required to prevent loads being applied to the device body.
- Drain holes in the device body and discharge piping, when applicable, must be open to allow drainage of liquids from over the device disk on spring loaded valves. Any liquid allowed to remain on top of the device disk can adversely affect the operating characteristics of the device.
- Most jurisdictional requirements state the device must be "piped to a point of safe discharge." This must be accomplished while keeping the run of discharge piping as short as possible. Most jurisdictions also limit the number of 90 degree elbows that may be installed in the discharge piping. Too long of a run and multiple elbows can adversely affect the operation of the device.

3. Inspection

While inspecting a boiler or pressure vessel, the inspector will also be evaluating the pressure relief device(s) installed on, or associated with, the equipment. The inspector should:

- Compare the device nameplate set pressure with the boiler or pressure vessel maximum allowable working pressure (MAWP) and ensure the device set pressure does not exceed the MAWP. A device with a set pressure less than MAWP is acceptable. If multiple devices are used, at least one must have a set pressure equal to or less than the MAWP. The ASME Code should be reviewed for other conditions relating to the use of multiple devices.
- Ensure the device still has the device manufacturer's seals intact. These seals can be in the form of wire through a drilled hole with a soft metal button, such as lead, crimped on the wire, or removable parts may be stake punched or crimped to inhibit accidental movement. Any evidence of the seal mechanism being broken or destroyed could indicate tampering. If this is found, the inspector should require replacement of the device or repair by a qualified organization.
- Verify the discharge of the device is piped to a safe point of discharge.
- Instruct the owner or owner's representative to lift the test lever, if so equipped, on spring-loaded devices. Section IV devices can have the test levers lifted without pressure in the boiler. All other devices must have at least 75% of the device set

pressure under the device disk prior to lifting the test lever. If the device is found to be stuck in a closed position, the equipment should be immediately removed from service until such time the device can be replaced or repaired.

- Lifting the test lever of a spring-loaded device may not be practical in all cases when inspecting pressure vessels. The contents of the vessel may be hazardous. In these cases, the vessel owner/user should have a testing procedure in place which will ensure documented inspection and testing of the device at regular intervals.
- The small pressure relief devices found on many air compressor vessels have a ring inserted through a drilled hole on the end of the device stem. These are tested by pulling the stem straight out and then releasing. The discharge openings in this type of device are holes drilled around the periphery of the device. These holes often get filled with oily dust and grit which can cause eye damage when the device is tested. A rag, loosely wrapped around the device when testing, can help prevent personal injury from the dust and grit.
- Detailed testing and operational inspection guidelines can be found in the *National Board Inspection Code*, paragraph RB-8400.
- Recommended inspection and test frequencies can be found in the *National Board Inspection Code*, paragraph RB-8410.

4. Miscellaneous Information

Additional information to aid inspections of pressure relief devices, including installation requirements, can be found in the following publications and sources:

- *National Board Inspection Code*
- ASME Section I
- ASME Section IV
- ASME Section VI
- ASME Section VII
- ASME Section VIII (Divisions 1, 2, and 3)
- ASME Section X
- ASME CSD-1
- manufacturer's installation, operation, and maintenance documentation
- jurisdictional laws, rules, and directives

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